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The terrestrial Invertebrate fauna of Mingulay, including 18 new species records for the Outer Hebrides

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ABSTRACT

Field investigations of the invertebrate fauna of the island of Mingulay in the Outer Hebrides were carried out during the summer of 2013. The resulting species list also includes published records from the island prior to our visit. A total of 303 terrestrial invertebrate species are listed, over 60% of those we found were new to the island. The vast majority have been previously recorded from the better studied and more accessible islands of Barra and South Uist. There are 18 species (3 coleoptera, 14 diptera and 1 hymenoptera) that appear to be first records for the Outer Hebrides. The most interesting finds were generally from cliff seepages and recently vacated puffin burrows. These and other interesting finds, including species of conservation concern, are discussed in more detail.

INTRODUCTION

The non-marine invertebrate fauna of the Outer Hebrides was comprehensively reviewed in 1981 by A.R. Waterston of the Royal Scottish Museum Edinburgh. Waterston joined Edinburgh University's 1935 expedition to investigate the natural history of Barra. This began a lifelong interest in the Outer Hebrides and he spent much of his last 30 years on Barra (Shaw; 1996, Heppell, 1996). Consequently the invertebrate fauna of this relatively accessible island has received some attention. Invertebrate records for the uninhabited, smaller islands south of Barra, including Mingulay, are sparse by comparison. Exposure to wind, swell and strong tides and terrible winter storms does limit access to them and consequently the number of visitors, including those of entomologists. Those with a fondness for remote, uninhabited Hebridean islands and potentially unpleasant voyages have historically turned their attentions to St Kilda.

John William Heslop Harrison, Professor of Botany at King's College, Durham, was one of the main sources of Mingulay records on Waterston's list. Harrison and his students carried surveys of the insects and non-marine molluscs of the Inner and Outer Hebrides between 1936 and the 1960s and published numerous short papers and notes detailing many unusual finds for these islands (Waterston, 1981). Heslop Harrison has been criticised for not retaining voucher specimens to validate many of his finds. Some of his unusual botanical records from these expeditions are now regarded as spurious. Around 1937-38 Dr W. A. Clark and Dr George Heslop Harrison (son of John William) from the Durham expedition had stopped at Mingulay en route to Barra and collected specimens (Heslop Harrison, 1938).

J W Heslop Harrison gave specimens from Mingulay to Frank Balfour-Browne, the doyen of British water beetles. Balfour-Browne (1953) published the species he identified in his own paper. The water beetles are the most comprehensively covered group of insects from Mingulay to date.

Tom Warwick from Edinburgh University's zoology department collected a number of invertebrates, mainly beetles and snails, during his Mingulay field work investigating Hebridean field mice. His specimens were identified by A.R. Waterston and published in Scottish Naturalist in 1939 (Warwick 1939).

The National Biodiversity Network (NBN) Gateway (data.nbn.org.uk) has been useful in highlighting some more recent records and identifications. Some caddisfly specimens attributed to Heslop Harrison collected in 1937 and deposited in the Natural History Museum (NHM), London now been identified by Ian Wallace (Liverpool Museums), who runs the Trichoptera recording scheme. Waterston did include records from the NHM collections in his review but evidently not quite all of them.

The Royal Airforce Ornithological Society visited Berneray and Mingulay on three occasions to study the birds. Each visit also generated a small number of invertebrate records, which are on the NBN. They visited from the 10th June-5th July in 1979 and 1985 and once again from the 31st-13th June 1993.

The Highland Biological Recording Group (HBRG) has submitted Mingulay records to the NBN. Murdo Macdonald (HBRG) is responsible for most of these following a productive day trip on the 6th July 2009. Other recorders have contributed a handful of species records between 2003 and 2009.

Between the 6th June and 15th of June 2013 Adam Cross, a PhD student at Glasgow University stayed on Mingulay to study the puffin colonies but he also made time to collect a few invertebrates, which he has donated to Geoff Hancock at the Hunterian Museum, Glasgow for identification and safe-keeping.

METHODS

By visiting Mingulay to look specifically at the invertebrates, harnessing the skills of several entomologists with broad entomological interests, we intended to update and enhance the species list for the island. This list would serve as more useful base line for future habitat management and research.

The survey team comprised: Dr Eleanor Slade, Researcher at the Department of Zoology, University of Oxford; Darren Mann, Head of Life Collections, Oxford University Museum of Natural History; Geoff Hancock, Curator of Entomology at the Hunterian Museum, Glasgow University; Jeanne Robinson, Curator of Entomology, Glasgow Museums; Steve Hewitt, Keeper of Natural History, Tullie House Museum, Carlisle.

The survey was planned for the period 31st July 2013 to 2nd August 2013. Apart from the days of arrival and departure, the weather was far from ideal, with high winds and frequent heavy rain. Due to the weather, the boat was unable to take us back to Barra until morning of the 4th, giving us 2 extra days of surveying.

Sweeping, beating, hand collecting and a range of aquatic invertebrate sampling techniques were carried out each day. We set two malaise traps and a Heath trap in a variety of habitats. Details of the timing and location of the traps are given in the trapping schedule below. We conducted night searches for invertebrates by torchlight, when the weather permitted. After getting approval from the site's bird warden, we excavated a few recently vacated puffin burrows in the hunt for invertebrate specimens.

Cheke and Reed (1987) produced notes on the flora of Mingulay based on Cambridge University's field observations in 1964. The flora at this time was still subject to sheep grazing. The last sheep were taken off the island 8 years ago so there have been changes in the floral composition. Despite the changes, Cheke and Read's notes were still useful for highlighting areas of geological and botanical interest that were likely to support interesting invertebrates. There is a fertile valley in the east of the island, where thick layers (15-20 ft) of boulder clay were deposited on top of the gneiss and granite by receding ice at the end of the last ice age. This valley supports the island's most diverse flora. The 'aspen cliff' (NL566828) within this valley is described as one of the most botanically interesting communities of the Barra Isles. It still supports Aspen (*Populus tremula*). The rest of the island is generally thin acidic soils, peat or bare rock. A lot of the sweeping, collecting and trapping was focused in the most botanically diverse areas around Mingulay Bay. Due to the number of interesting species associated with the coastal dunes of the Western Isles, this habitat was comprehensively surveyed. We also obtained a good sample of the moorland inhabitants.

The aquatic sampling included stream samples (kick sampling, sweeping, collection of invertebrates adhered to substrate) from the higher, middle and lower reaches of the streams; including those that run down to Aneir, those behind the school house and the those that descend from Biulacraig into Mingulay Bay.

We sampled the moss at various altitudes on the ascent to the summit of Hecla and Builacraig. We sampled pools around Tom à Mhaide, approaching Builacraig and Carnan. We sampled brackish pools and seepages along the sea cliffs and caves of Mingulay Bay.

Several samples were brought home for rearing, including micro-moth caterpillars on angelica (*Angelica* sp.) and burdock (*Arctium* sp.); leaf mined leaves of scurvygrass (*Cochlearia* spp.), ragwort (*Senecio* sp.) and sow thistle (*Sonchus* sp.). Pupae collected from the vacated puffin burrows were brought back for rearing. Adults and various associated parasites were successfully reared from all these samples.

Sampling/trapping schedule

31st July - Slightly cloudy with bright spells. Moth trap in the dunes by the stream (NL564832). Malaise traps over stream in Mingulay Bay (NL564833) and in bog behind school house (NL564828). Dry during the night when we searched around Mingulay Bay, the dunes and the environs of the school house.

1st August - Very wet and windy. Moth trap set up in bog behind school house (NL565828) – collapsed during the night and sunk in the bog. Malaise traps kept at same sites as the previous night.

2nd August - Wet and windy. Malaise traps moved to the dunes (NL565833) and bog south east of the school house (NL567826). Moth trap set up in

sheltered stream valley (NL565829). Investigated puffin burrows (NL5683).

3rd August - Wet and windy. Malaise traps kept in the dunes (NL565833) and bog south east of the school house (NL567826). Aquatic sampling.

4th August am – Bright and sunny. Some opportunities for sweeping and grubbing before the boat came.

Our field work has been the principle source of records. The main sources of information regarding existing records have been Waterston (1981), National Biodiversity Network (NBN) Gateway and the Highland Biological Recording Group (HBRG). Recording Scheme websites, online distribution maps and the Scottish Invertebrate Records Index (SIRI) at the National Museums of Scotland (NMS) have also been consulted to help establish the current distribution of the species. See 'Further web tools' in the reference section for details.

We have identified the specimens that fall within our own area of expertise. We have distributed as much material as we can to willing experts in other groups. There are parasitoids, flies and other miscellaneous specimens yet to be identified.

Voucher specimens have been retained for those species we were unable to identify in the field. These can be found in Glasgow Museums; the Hunterian (Zoology Museum), University of Glasgow, Tullie House Museum, Carlisle, and Oxford University Museum of Natural History.

Oxford University Museum of Natural History have over 1000 aquatic Hemiptera and water beetles collected by Heslop Harrison from the Outer Hebrides. The National Museums of Scotland and the NHM potentially have further material from this area. There may be unpublished material from Mingulay in amongst them. The institutions have been contacted to see what they have from Mingulay but in general these specimens are not on a searchable database. Research trips to physically go through these collections and extract data may augment the number of historical records.

RESULTS AND DISCUSSION

See Full species list is given in Appendix 1.

A total of 303 species are now recorded from Mingulay. The rarer and more interesting insect finds are discussed in more detail below.

Lepdoptera

Of the 17 butterfly species recorded from the Outer Hebrides, 9 have now been seen on Mingulay (Waterston, 1981; http://www.western-isles-wildlife.co.uk). Dark green fritillaries (*Argynnis aglaja*) were very numerous around Mingulay Bay at the beginning of August, nectaring on creeping thistle and devil's bit scabious. The common blue (*Polyommatus icarus*) and meadow browns (*Maniola jurtina)* were also abundant in this area.

There were fewer graylings (*Hipparchia semele*) on the wing. Graylings are designated as a priority species in 2007 on the basis of their continued decline in England. They face a range of threats including destruction of lowland heath, building development and golf courses on sand dunes and agricultural intensification. However, many new colonies have been recently discovered in western Scotland and it is probably under-recorded here (Masterman, 2011).

We saw just one small white (*Pieris rapae*) and a red admiral (*Vanessa atalanta)* during our stay. The small white appears not to have been previously recorded from Mingulay. They are known from elsewhere in the Outer Hebrides (Waterston, 1981; http://www.western-isles-wildlife.co.uk).

Heslop-Harrison recorded both large (*Coenonympha tullia*) and small heath (*Coenonympha pamphilus*) on the island in 1938. Our 2013 visit was at the end of their potential flight period; but there were no new sightings. No further painted ladies (*Vanessa cardui*) were observed either, which were observed earlier in the season, 6th July 2009 (data.nbn.org.uk).

There are now 38 moth species recorded from Mingulay. Approximately a quarter of these had not been recorded on the island before but almost all have been previously recorded from Barra. The straw dot (*Rivula sericealis*) and the small wainscot (*Chortodes pygmina*) and the ruddy flat-body (*Agonopterix subpropinquella* f. *rhodochrella*) are the exceptions (Waterson 1981 and data.nbn.org.uk).The straw dot was first recorded in the Outer Hebrides in 2006 (http://www.western-isles-wildlife.co.uk), the small wainscot a while before (Waterston, 1981); both appear to be extending their range in these islands. The ruddy flat-body is generally uncommon in Scotland. In the Outer Hebrides, the only previous records are from Lewis (http://www.eastscotland-butterflies.org.uk/sm_Oecophoridae.html). It is thriving on Mingulay. We reared it from caterpillars collected on burdock and spear thistle.

The Scottish populations of the belted beauty (*Lycia zonaria atlantica*) are classic machair species, they are classified as nationally scarce A (http://butterfly-conservation.org/1866-1094/belted-beauty.html). The distinctive looper caterpillars, with their bold yellow lateral stripes are very abundant in Mingulay's dunes at the beginning of August.

Garden tiger (*Arctia caja*) caterpillars and adult moths were also extremely abundant during our

visit. Once widespread in Britain, this species has suffered an 80% reduction in the last 35 years. They are now classified as a priority species in the UK BAP (http://jncc.defra.gov.uk/speciespages/2053.pdf).

The white-lined dart (*Euxoa tritici*) and small square spot (*Diarsia rubi*) are both UK BAP listed species too; due to a 92% and 85% decline respectively, over the last 35 years (http://jncc.defra.gov.uk/ speciespages/1151.pdf, http://jncc.defra.gov.uk/ speciespages/2219.pdf). *E. tritici* was one of the most abundant moths in the light traps on Mingulay and *D. rubi* is relatively common resident of the Outer Hebrides (http://www.western-isles-wildlife.co.uk/white-line dart to red sword grass.htm).

Coleoptera

Waterston (1981) recorded 605 beetles from the Outer Hebrides and suggested there were probably around 700 species in total. Beetles were the best recorded insect group on Mingulay before our visit. A total of 33 species have been added to the beetle list; there are still only 56 species from 14 families. Seven of the species found appear to be new to Mingulay. Most of the species additions have formerly been recorded from Barra.

The ground beetles *Nebria rufescens* and *Paranchus albipes*, predaceous diving beetle *Hydroporus longulus*, small carrion beetle *Sciodrepoides watsoni* and the rove beetles *Stenus ochropus, Quedius maurorufus* and *Ocypus brunnipes* are new to Mingulay (Waterson, 1981 and data.nbn.org.uk). *N. rufescens, P. albipes* and *H. longulus* were found in association with seepages. *S. watsoni* is a species associated with rabbit and puffin burrows, they may have been on the island for sometime, where they would be easily missed by more general surveys.

Q. maurorufus is described as widespread in the UK (Lott and Anderson, 2011) but does not appear to have been recorded from the Outer Hebrides before. There are records from the Ebudes on SIRI (written communication with Richard Lyszkowski, National Museums of Scotland 5/12/2013 and 6/1/2014).

O. brunnipes is one of the more commonly encountered *Ocypus* species (Lott and Anderson, 2011) that is generally local and widespread north of the border in the UK (data.nbn.org.uk). There are Scottish records on SIRI including sightings from the Inner but not the Outer Hebrides (written communication with Richard Lyszkowski, National Museums of Scotland 5/12/2013 and 6/1/2014).

The rove beetle *S. ochropus* (=*erichsoni* Rye) is a more unusual find. Its' British distribution is described as scattered in Central and Southern England (Lott and Anderson, 2011). There are published records for the species from Ayrshire (VC75), Lanarkshire (VC77) and Stirlingshire (VC86). We are aware of no records north of these locations or from the Scottish Islands. (written communication with Richard Lyszkowski, National Museums of Scotland 13/2/2014).

The few silphids and large carabids we encountered were generally heavily infested with mites; one *Nicrophorus investigator* was so laden it could hardly move. The mutualistic mites on the Mingulay specimens are *Poecilochirus carabi,* which have been previously recorded from Lewis in the Outer Hebrides (Waterson, 1981).

No beetles of conservation concern were encountered during our surveying.

Diptera

There are a total of 769 flies recorded from the Outer Hebrides (Skidmore, 2008). A total of 111 species belonging to 27 families are now recorded from Mingulay. Most of these species (95 of the 111) had not been recorded from the island and 14 of these were not previously known from the Outer Hebrides (Waterston,1981; data.nbn.org.uk ; Skidmore, 2008); these include the long-legged flies *Chrysotus cilipes, Dolichopus festivus, Raphium brevicorne*; the dance flies *Chersodromia incana* and *Kowarzia bipunctata*; the heleomyzid *Oecothea praecox*, the crane flies *Gonomyia conoviensis* and *Dicranomyia goritiensis,* the anthomyiid flies *Leucophora grisella, Hylemya urbica* and *Botanophila jacobaeae*, the muscid fly *Lispe pygmaea,* the tachinid fly *Siphona setosa* and the marsh fly *Trypetoptera punctulata*.

The British distribution of the Long-legged flies *C. cilipes, D. festivus and R. brevicorne* is described as 'frequent', 'common' and 'local' in the Western Isles respectively. There are all listed from sites in the Ebudes but there appear to be no current records for the Outer Hebrides. *R. brevicorne* has been previously found in the wetlands of Eigg and Rum (Skidmore, 2008).

The dance fly *C. incana* receives no mention in Skidmore (2008), indicating that it is not currently recorded from anywhere in the Western Isles. *K. bipunctata* is recorded from the wetlands of Mull, Rum and Skye in the Ebudes and is described as frequent in the Western Isles generally by Skidmore (2008).

The heleomyzid *O. praecox* is a nationally notable/scarce species that appears to be rarely recorded in Scotland and may not have been recorded breeding here before (Written communication David Horsefield, Malloch Society, 27 November 2013). We reared it from pupa collected in debris from vacated puffin burrows on Mingulay. The species is not mentioned in

Skidmore's (2008) review of the Diptera of the Outer Hebrides.

The crane fly *D. goritiensis* (synonym: *Limonia goritiensis*) is classified as rare in the red data book for invertebrates – RDB3. In general this species is widely scattered but very local, with most records originating from South-West England and Wales the UK. It has been recorded from Mull and Skye (Skidmore, 2008). The biology is largely unknown but its larvae have been found in saturated grass tufts in and around seepages on coastal cliffs (Stubbs 1998, Boyce 2002). E.G. Hancock has previously recorded this species from the maritime cliffs of Islay, in the Inner Hebrides (Hancock, 2008). Some species of *Dicranomyia* are quite salt tolerant but this species generally found higher up and further out of the salt spray. We found larvae living inside clumps of Cladophora growing along with moss on the vertical rock faces through which water was trickling on Mingulay's coastal cliffs and caves. Only adults were observed in the sea cave whose walls were covered in scurvy grass. (NL569833). Managing this species requires the safeguarding of seepages on cliffs, maintaining natural drainage and any associated vegetation (Falk, 1991).

The immatures appear not to have been described before. Unfortunately the larvae pupated before we got home so they will remain so for a little longer. The pupae are however highly distinctive with their crenulated / corrugated ('zip like') dorsal line. They have prominent horned prothoracic spiracles with knobbed ends, which resemble butterfly antenna.

Fig. 1. Previously undescribed puparia of *D. goritiensis*

D. goritiensis, and some of the other species we found with it, are characteristic of stable cliff seepages. This habitat is found scattered around the whole of the British coast, wherever the geology is suitable for their development. This is currently a very poorly known habitat, and further survey work is required before we will be able to categorise the invertebrate communities and their ecological requirements more precisely (Boyce, 2002).

Table 1: Invertebrates associated with stable cliff seepages found on Mingulay (*see appendix 1*).

Order	Family	Species
Diptera	*Limonidae*	*Dicranomyia goritiensis*
Diptera	*Limonidae*	*Gonomyia conoviensis*
Trichoptera	*Psychomyiidae*	*Tinodes assimilis*
Trichoptera	*Psychomyiidae*	*Tinodes maclachlani*

The crane fly *G. conoviensis* is a nationally rare/notable species also associated with the seepages on Mingulay. It has been previously recorded from Lismore, Rum and Mull in the Inner Hebrides but not formerly from the Outer Hebrides (Skidmore, 2008). It is suggested this species should be managed by safeguarding seepages on cliffs and rock faces by maintaining natural drainage patterns and any associated vegetation (Falk, 1991).

The distribution of the anthomyiid *L. grisella* is described as local and *H. urbica* as frequent in the Western Isles; both have only previously been recorded from Rum in these islands. *B. jacobaeae*

The marsh fly *T. punctulata* is frequent and widespread in the Ebudes but appears to be unrecorded for the Outer Hebrides (Skidmore, 2008). It shows a fondness for calcareous habitats. It's commonly associated with woodland but has also been found on grassland and along the edges of streams (Rozkosný, 1984).

Shore flies are generally characteristic of wet places, river and lake margins and seashore for example. This is why E G Hancock was intrigued when he found adults of this family in Mingulay's dunes. These have now been identified as *Philygria punctatonervosa*, whose distribution is described as local in the Western Isles (Skidmore, 2008). This genus is apparently unusual for inhabiting drier habitats like sand dunes or well drained sandy soil areas. The larvae are thought to live below the surface where it is damper and they can graze on algae growing in the interstices of the sand grains, but they have actually not been seen to do this. This species is recorded from Iona, Rum, Lewis, North and South Uist (Skidmore, 2008) and Norwich Museum has unpublished specimens collected by Tony Irwin from the dunes of Colonsay and Oronsay in 1978. The wing patternation of this genus is quite distinctive but the flies are small (<2mm) and not many people are looking for them. They are likely to be more widely distributed than current records indicate.

Calliphora uralensis; a rare boreal blowfly or bluebottle (red data book category 3) is restricted to Scotland in Great Britain. This mainly coastal

species is associated with carrion derived from the islands' breeding bird colonies. It is the predominant species elsewhere in the Outer Hebrides, including Barra (Davies 1987; Waterston 1981) but was nowhere to be found on Mingulay. Only *C. vomitoria* and *C. vicinia* were present. Davies (1987) suggested that the lack of records between Barra and Ireland and Ailsa Craig was due to lack of recording but it appears to be a genuine absence.

Hymenoptera

Waterston (1981) recorded 106 Hymenoptera species but most of these were parasitica. We collected some parasitica which are awaiting identification. There are now 10 species of hymenoptera (aculeates and symphyta) from 5 different families recorded on Mingulay. Two of these species have not been recorded on the island before, the sawflies *Euura atra* and *Pontania collatanea*, which are known from Barra.

The field digger wasp (*Mellinus arvensis*) has not previously been recorded from the Outer Hebrides (Murdo Macdonald and Bill Neil, OHBRG and HBRG, written communications 11th and 14th Nov 2013 respectively). It is a relatively coldhardy species that is widespread and common so able to exploit Mingulay's sandy soils and fly prey. The population appears well established. Males and females were active around the school house and sheltered valleys around Mingulay Bay dunes.

During the course of the visit we spotted at least 3 great yellow bumblebees *Bombus distinguendus* nectaring on the island. Great yellow bumblebees have declined by 70% since 1990 in the UK. They are now entirely restricted to the North and west of Scotland (http://jncc.defra.gov.uk/speciespages/152.pdf). This species is nationally notable B; it is on the Scottish biodiversity list (SBL) of species of principal importance for biodiversity conservation and is a UK biodiversity action plan (BAP) priority species. Lesser burdock, spear thistle, ragwort and knapweed on the island will provide forage for workers, males and a few queens from late July through August (Charman et al. 2009).

Moss carder bees (*Bombus muscorum*) are active on Mingulay. This species is also listed on the BAP and SBL lists (http://jncc.defra.gov.uk/ speciespages/2089.pdf and http://jncc.defra.gov.uk/ speciespages/235.pdf). Like the great yellows, they are commonly found in association with the Hebridean machair too. Several moss carder bees were seen in Mingulay Bay and the valley behind it during our visit.

Sward height must be managed to maintain optimum flowering to support great yellow and moss carder bee populations. It is recommended that their habitats are managed, through grazing and cutting prescriptions, to maintain, and where appropriate, enhance the area of habitat in suitable condition for these species and that monitoring is needed to understand the status of the species at existing sites. This data is needed to allow reporting against success criteria (http://jncc.defra.gov.uk/ speciespages). There are no livestock left on the island, the last sheep were taken off 8 years ago. The only remaining grazers are the rabbits, who a re culled periodically to help preserve the archaeology on the island.

The solitary bee *C. succinctus,* filled the dunes during our visit. *C.succinctus* is generally recorded between mid-July to late September typically on heath, ragwort, yarrow, melliot and creeping thistle (Else, December 2011).

The only symphyta found on Mingulay were those associated with willow; the willow gall sawfly (*P. pedunculi*), which galls the leaves, had been previously recorded here; the smaller willow shoot sawfly *Euura atra and the* leaf galling - *Pontania collactanea,* are new to the island but previously recorded from Barra. All three of these species Waterston stated were breeding in the Outer Hebrides in his 1981 review.

Only 4 species of ants were recorded in the Outer Hebrides. The only active ants in August 2013 on Mingulay were *Myrmica ruginodis,* which were already recorded for the island (Waterston, 1981). This species was evidently mating at the beginning of August in 2013 as males, workers and winged queen ants were all found in the dunes.

Hemiptera

There were 67 species of Heteroptera recorded for the Outer Hebrides, about half of which are aquatic. There were 7 aquatic bugs recorded from Mingulay (Waterston 1981 and data.nbn.org.uk). Despite extensive aquatic sampling none of these species were refound. The only aquatic bug we encountered was the water cricket (*Velia caprai*), which is now ubiquitous. It hadn't been previously recorded for Mingulay. An additional 10 terrestrial hemiptera were recorded during our 2013 visit, all of which were already recorded from Barra. None of the Hemiptera found in 2013 are currently of any conservation concern.

Trichoptera

There were no records of caddis from Mingulay in Waterston but NBN had records for 4 species collected by Heslop Harrison in August 1937 (data.nbn.org.uk). These specimens have been recently identified from the collections of the NHM, London (Ian Wallace, Pers. Comm. 2013). Three of the four species; *Limnephilus sparsus, Philopotamus montanus* and *Plectrocnemia conspersa* are still very numerous on the islands. All three were present in

their immature stages in August 2013, showing them to be breeding on the island. We found 5 species that are new to Mingulay, but all are known from elsewhere in the Outer Hebrides. Both *Tinodes machlachlani* and *Tinodes waeneri* are associated with the Mingulay cliff seepages, which as discussed in the Diptera, is a very interesting habitat. No specimens of *Limnephilus hirsutus*, which was active in 1937, were found during this visit. None of the caddis recorded are currently of conservation concern.

Small orders

Only one species of mayfly was recorded during this visit and during previous visits, the large dark olive *(Baetis rhodani)*. It is one of the most common and widespread ephemeroptera species; found throughout the British Isles. We found numerous nymphs in the streams.

No odonata were spotted during this visit despite previous records of blue tailed damsel and golden ringed dragonfly despite our visit being during their flight period.Only one immature stonefly was seen during our visit but not captured.

One psocoptera specimen was but was too badly damaged to identify. There are no previous records for booklice from Mingulay.

There are only 4 species of orthoptera recorded in the Outer Hebrides, 2 of these were found on Mingulay previously, the common green grasshopper (*Omocestus viridulus*) and common earwig (*Forficula auricularia*) (Waterston,1981). The earwig is still there in great abundance, particularly on the ragwort in the dunes at night. No green grasshoppers were active during our visit; only mottled grasshoppers were found this time. They were also very active in the dunes.

Arachnida

The common wolf spider (*Pardosa pullata*) was the only arachnid previously recorded on Mingulay, which were still doing well in the summer of 2013. There are now 10 species records from 7 different families, nothing surprising.

Gastropoda

The gastropods were one on the best studied groups of terrestrial invertebrates on the island. There are now 22 species belonging to16 familes recorded from Mingulay; only 4 of these were added to the list as a result of our 2013 fieldwork. These include the wrinkled snail (*Candidula intersecta*), which we found in some numbers in the vacated puffin burrows; the New Zealand mud snail or Jenkin's spire shell (*Potamopyrgus antipodarum*), the greenhouse slug (*Milax gagates*) and the dwarf pond snail (*Galba trunculata*). The mud snail has already shown itself to be a good traveller, reaching the UK from the other side of the world in the middle of the 1800s. It is now established in considerable numbers in Mingulay's water sources (http://jncc.defra.gov.uk/page-1713 accessed 03/02/2014). Most of the specimens are what one would expect from previous records, but *M. gagates* seems to be new to the area, but perhaps not altogether surprising as it is mainly a coastal species (written comm. Adrian Sumner 13/01/2014).

This species list could certainly be enhanced with a visit earlier in the season or in the event of more obliging weather conditions. Suction sampling the grassland and moorland could further enhance the records.

The authors would be interested to hear of any terrestrial invertebrate records from the island of Mingulay.

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FURTHER WEB TOOLS

Bees, wasps and ants recording society http://www.bwars.com/
Hoverfly recording scheme http://www.hoverfly.org.uk/
Western Isles Wildlife http://www.western-isles-wildlife.co.uk/index.htm
Scottish Micro Moths http://eastscotland-butterflies.org.uk/scottishmicros.html
Scottish Water Beetles http://www.snh.org.uk/pdfs/publications/commissioned_reports/F00AC337.pdf
Spider and Harvestman Recording Scheme website http://srs.britishspiders.org.uk/
UK moths http://ukmoths.org.uk/

Appendix 1. Terrestrial Invertebrate species recorded from the island of Mingulay.

Order	Last record		Last record
Coleoptera			
Carabidae		Dytiscidae continued...	
Abax parallelepipedus (Pil. & Mitt., 1783)	2013*	*Hydroporus longulus* Mulsant & Rey, 1861	2013*
Amara aenea (De Geer, 1774)	1900	*Hydroporus obscurus* Sturm, 1835	1937
Bembidion tetracolum Say, 1825	1900	*Hydroporus pubescens* (Gyllenhaal, 1808)	2013
Calathus fuscipes (Goeze, 1777)	2013	*Ilybius aenescens* Thomson, C.G., 1870	1937
Calathus melanocephalus (Linnaeus, 1758)	2013*	Elateridae	
Calathus mollis (Marsham, 1802)	2013*	*Hynoides riparius* (Fabricius, 1792)	2013
Carabus granulatus Linnaeus, 1758	2013	Gyrinidae	
Carabus problematicus Herbst, 1786	1979	*Gyrinus minutus* Fabricius, 1798	1937
Curtonotus aulicus (Panzer, 1796)	2013	*Gyrinus substriatus* Stephens, 1828	1937
Harpalus latus (Linnaeus, 1758)	2013*	Hydrophilidae	
Harpalus rufipes (De Geer, 1774)	1900	*Anacaena globulus* (Paykull, 1798)	2013
Nebria brevicollis (Fabricius, 1792)	2013*	*Chaetarthria simillima* Vor. & Cup., 2003	2013*
Nebria rufescens (Ström, 1768)	2013*	*Coelostoma orbiculare* Fabricius 1775	2013*
Nebria salina Fair. et Labou., 1854	2013*	*Enochrus fuscipennis* (Thomson, 1884)	2013*
Notiophilus biguttatus (Fabricius, 1779)	1900	*Helophorus flavipes* Fabricius, 1792	2013*
Paranchus albipes (Fabricius, 1796)	2013*	*Megasternum obscurum* (Marsham, 1802)	2013
Pterostichus niger (Schaller, 1783)	2013*	Leiodidae	
Pterostichus nigrita (Paykull, 1790)	1900	*Sciodeproides watsoni* (Spence, 1815)	2013*
Pterostichus strenuous (Panzer, 1796)	1900	Scarabaeidae	
Chrysomelidae		*Aegialia arenaria* (Fabricius, 1787)	2013*
Longitarsus jacobaeae (Waterhouse., 1858)	2013*	*Serica brunnea* (Linnaeus, 1758)	2013*
Longitarsus luridus (Scopoli, 1763)	2013*	Scirtidae	
Cryptophagidae		A marsh beetle immature	2013*[i]
Micrambe villosa (Heer, 1841)	2013*	Silphidae	
Curculionidae		*Nicrophorus investigator* Zetterstadt, 1824	2013*
Barynotus squamosus Germar, 1824	2013	Staphylinidae	
Otiorhynchus atroapterus Stephens, 1829	2013*	*Aleochara obscurella* (Gravenhorst, 1806)	2013*
Philopedon plagiatus (Schaller, 1783)	2013*	*Ocypus brunnipes* (Fabricius, 1781)	2013*
Dryopidae		*Ocypus olens* O. F. Müller, 1764	2013*
Dryops luridus (Erichson, 1847)	2013*	*Quedius laevicollis* (Brullé, 1832)	2013*
Dytiscidae		*Quedius maurorufus* (Gravenhorst, 1806)	2013*
Agabus (Acatodes) arcticus (Paykull, 1798)	1937	*Staphylinus erythropterus* Linnaeus, 1758	2013
Agabus bipustulatus (Linnaeus, 1767)	2013	*Stenus ochropus* Kiesenwetter, 1858	2013*
Hydroporus erythrocephalus (Linn., 1758)	1937	*Xantholinus linearis* (Olivier, 1795)	2013*
Hydroporus gyllenhalii (Gyllenhaal, 1808)	2013*		
Diptera			
Agromyzidae		Limonidae continued...	
?Agromyza lucida Hendel, 1920	2013*	*Gonomyia conoviensis* Barnes, 1924	2013*[i]
Agromyza mobilis Meigen, 1830	2013*	*Molophilus obscurus* (Meigen, 1818)	2013*
Chromatomyia syngenesiae Hardy, 1849	2013*[i]	*Phylidorea ferruginea* (Meigen, 1818)	2013*
Anthomyiidae		*Symplecta stictica* (Meigen, 1818)	2013*
Anthomyia liturata (Robineau-Desvoidy, 1830)	2013*	Lonchopteridae	
Botanophila fugax (Meigen, 1826)	2013*	*Lonchoptera lutea* Panzer,1809	2013
Botanophila jacobaeae (Hardy, 1872)	2013*	Muscidae	
Botanophila striolata(Fallén, 1824)	2013*	*Coenosia mollicula* (Fallén, 1825)	2013*
Delia platura(Meigen, 1826)	2013*	*Coenosia tigrina* (Fabricius, 1775)	2013*
Hylemya urbica Van der Wulp, 1896	2013*	*Drymeia hamata*(Fallén, 1823)	2013*
Leucophora grisella Hennig, 1967	2013*	*Helina evecta*(Harris, 1780)	2013*
Pegomya bicolor (Wiedemann, 1817)	2013*	*Helina quadrum* (Fabricius, 1805)	2013*
Calliphoridae		*Helina subvittata* (Séguy, 1923)	2013*
Calliphora uralensis Villeneuve, 1922	2013*	*Hilara ?biseta*	2013*

Calliphora vicina Robineau-Desvoidy, 1830	2013*
Calliphora vomitoria (Linnaeus, 1758)	2013*
Cynomya mortuorum (Linnaeus, 1761)	2013*
Chamaemyiidae	
Chamaemyia flavipalpis (Haliday, 1838)	2013*
Chloropidae	
Cetema elongatum (Meigen, 1830)	2013*
Chlorops ?calceatus	2013*
Meromyza pratorum Meigen, 1830	2013*
Dolichopodidae	
Aphrosylus celtiber Halliday, 1855	2013*
Aphrosylus ferox Haliday in Walker, 1851	2013*
Argyra argentina (Meigen, 1824)	2013*
Campsicnemus scambus (Fallén, 1823)	2013*
Chrysotus cilipes Meigen, 1824	2013*
Dolichopus atratus Meigen, 1824	2013*
Dolichopus festivus Haliday, 1832	2013*
Dolichopus grisepennis Stannius, 1831	2013*
Dolichopus nubilus Meigen, 1824	2013*
Dolichopus plumipes (Scopoli, 1763)	2013*
Dolichopus urbanus Meigen, 1824	2013*
Liancalus virens (Scopoli, 1763)	2013*
Raphium brevicorne Curtis, 1835	2013*
Sympycnus desoutteri Parent, 1925	2013*
Drosophilidae	
Lordiphosa adalusiaca (Strobl, 1906)	2013*[i]
Scaptomyza flava (Fallén, 1823)	2013*[i]
Empidae	
Clinocera fontinalis (Haliday,1833)	2013*
Clinocera stagnalis (Haliday,1833)	2013*
Empis livida Linnaeus, 1758	2013*
Hilara chorica (Fallén, 1816)	2013*
Kowarzia bipunctata (Haliday,1833)	2013*
Rhamphomyia variabilis (Fallén, 1816)	2013*
Ephydridae	
Philgyria punctatonervosa (Fallén, 1813)	2013*
Faniidae	
Fannia fuscula (Fallén, 1825)	2013*
Fannia lepida (Wiedemann, 1817)	2013*
Heleomyzidae	
Heleomyza borealis (Boheman, 1865)	2013*
Oecothea praecox Loew,1862	2013*[i]
Hybotidae	
Chersodromia incana Haliday, 1851	2013*
Hybos culiciformis (Fabricius, 1775)	2013*
Platypalpus pallidiventris Macquart, 1827	2013*
Platypalpus strigifrons (Zetterstedt, 1849)	2013*
Tachypeza nubile(Meigen, 1804)	2013*
Lauxaniidae	
Minettia tubifer (Meigen, 1826)	2013*
Limonidae	
Dicranomyia autumnalis (Staeger, 1840)	2013*
Dicranomyia chorea (Meigen, 1818)	2013*
Dicranomyia goritiensis (Mik, 1864)	2013*
Dicranomyia mitis (Meigen, 1830)	2013*
Dicranophragma separatum (Walker, 1848)	2013*
Hydrotaea armipes (Fallén, 1825)	2013*
Hydrotaea dentipes (Fabricius, 1805)	2013*
Hydrotaea irritans (Fallén, 1823)	2013*
Limnophora olympiae Lyneborg, 1965	2013*
Limnophora riparia (Fallén, 1824)	2013*
Limnophora triangula (Fallén, 1825)	2013*
Lispe pygmaea Fallén, 1825	2013*
Phaonia errans(Meigen, 1826)	2013*
Schoenomyza litorella (Fallén, 1823)	2013*
Spilogona meadei (Schnabl in Becker, Dziedzicki, Schnabl & Villeneuve, 1915)	2013*
Thricops rostratus (Meade, 1882)	2013*
Mycetophilidae	
Acnemia nitidicollis (Meigen, 1818)	2013*
Boletina dubia (Meigen, 1804)	2013*
Brevicornu nigrofuscum (Lundström, 1909)	2013*
Opomyzidae	
Opomyza germinationis (Linnaeus, 1758)	2013*
Pediciidae	
Tricyphona immaculata (Meigen, 1804)	2013*
Scatophagidae	
Scatophaga litorea (Fallén, 1819)	2013*[i]
Sciomyzidae	
Pherbellia cinerella(Fallén, 1820)	2013*
Tetanocera ferruginea Fallén, 1820	2013*
Trypetoptera punctulata (Scopoli, 1763)	2013*
Stratiomyidae	
Chloromyia formosa (Scopoli, 1763)	2013*
Syrphidae	
Cheilosia bergenstammi Becker, 1894	2013*
Episyrphus balteatus (De Geer, 1776)	2009
Eristalis intricarius (Linnaeus, 1758)	2013*
Eupeodes corollae (Fabricius, 1794)	2009
Helophilus trivittatus (Fabricius, 1805)	2013*
Melanostoma mellinum (Linnaeus, 1758)	2013
Melanostoma scalare (Fabricius, 1794)	2013*
Platycheirus albimanus (Fabricius, 1781)	2013*
Platycheirus angustatus (Zetterstedt, 1843)	1939
Platycheirus clypeatus (Meigen, 1822)	2013*
Platycheirus immarginatus (Zetterstedt, 1849)	1939
Platycheirus manicatus (Meigen, 1822)	2013*
Platycheirus nielseni Vockeroth, 1990	2013*
Syrphus torvus Osten Sacken, 1875	2013*
Volucella bombylans (Linnaeus, 1758)	2013*
Tabanidae	
Haematopota pluvialis (Linnaeus, 1758)	2013*
Tachinidae	
Siphona setosa Mesnil, 1960	2013*
Siphona geniculata (De Geer, 1776)	2013*
Tipulidae	
Nephrotoma flavescens (Linnaeus, 1758)	2013*
Tipula lateralis Meigen, 1804	2013*
Tipula oleracea Linnaeus, 1758	2013*
Tipula paludosa Meigen, 1830	2013*
Tipula rufina Meigen, 1818	2013
Ulidiidae	
Herina frondescentiae (Linnaeus, 1758)	2013

Ephemoptera

Baetidae

Baetis rhodani Pictet, 1845	2013[i]

Hemiptera

Corixidae

Cymatia bonsdorffii (C.R. Sahlberg, 1819)	1942
Hesperocorixa castanea (Thomson, 1869)	1942
Sigara semistriata (Fieber, 1848)	1942
Sigara distincta (Fieber, 1848)	1942
Sigara scotti (Douglas & Scott, 1868)	1942

Gerridae

Gerris costae (Herrich-Schäffer, 1850)	1942

Lygaeidae

Scolopostethus decoratus (Hahn, 1833)	2013*

Miridae

Closterotomus norwegicus (Gmelin, 1790)	2013*
Leptopterna ferrugata (Fallén, 1807)	2013*

Hymenoptera

Apidae

Bombus distinguendus Morawitz, 1869	2013
Bombus lucorum (Linnaeus, 1761)	2013
Bombus muscorum (Linnaeus, 1758)	2013
Colletes succintus (Linnaeus, 1758)	2013

Crabronidae

Mellinus arvensis (Linnaeus, 1758)	2013*

Formicidae

Myrmica ruginodis Nylander, 1846	2013

Lepidoptera

Arctiidae

Arctia caja (Linnaeus, 1758)	2013[i]

Crambidae

Agriphila straminella (D & S, 1775)	1959-1981

Geometridae

Abraxas grossulariata (Linnaeus, 1758)	2013*
Camptogramma bilineata (Linnaeus, 1758)	2013
Chloroclysta citrata (Linnaeus, 1761)	2013
Chloroclysta truncata Hufnagel, 1767	1899-1960
Epirrhoe alternata (Müller, 1764)	2013*
Eupithecia centaureata (D & S, 1775)	2013*
Lycia zonaria (D & S, 1775)	2013[i]
Perizoma didymata (Linnaeus, 1758)	1899-1960
Xanthorhoe montanata (D & S, 1775)	1899-1960

Hepialidae

Hepialus fusconebulosa (DeGeer, 1778)	1959-1981

Lycaenidae

Polyommatus icarus (Rottemburg, 1775)	2013

Noctuidae

Acronicta rumicis (Linnaeus, 1758)	1899-1960
Agrotis vestigialis (Hufnagel, 1766)	2013*
Apamea lithoxylaea (D & S, 1775)	2013*
Apamea monoglypha (Hufnagel, 1766)	2013
Autographa gamma (Linnaeus, 1758)	2009
Autographa pulchrina (Haworth, 1809)	2013*
Cerapteryx graminis (Linnaeus, 1758)	2013
Chortodes pygmina (Haworth, 1809)	2013*

Miridae continued...

Mecomma ambulans (Fallén, 1807)	2013*
Pithanus maerkelii (Herrich-Schäffer, 1838)	2013*
Plagiognathus chrysanthemi (Wolff, 1804)	2013*
Trigonotylus ruficornis (Geoffroy, 1785)	2013*

Notonectidae

Notonecta obliqua Thunberg, 1787	1900

Saldidae

Saldula saltatoria (Linnaeus, 1758)	2013*

Tingidae

Tingis cardui (Linnaeus, 1758)	2013*

Veliidae

Velia caprai (Tamanini, 1947)	2013

Tenthredinidae

Euura atra (Jurine, 1807)	2013*
Pontania collactanea (Förster, 1854)	2013*
Pontania pedunculi (Hartig, 1837)	2013

Vespidae

Ancistrocerus scoticus (Curtis, 1834)	2013*

Noctuidae continued...

Lacanobia oleracea (Linnaeus, 1758)	2013
Luperina testacea (D & S, 1775)	1899-1960
Lycophotia porphyrea (D & S, 1775)	2013*
Mesapamea secalis (Linnaeus, 1758)	2013*
Mythimna impura (Hübner, 1808)	2013*
Mythimna pallens (Linnaeus, 1758)	2013*
Noctua comes Hübner,1813	1899-1960
Noctua pronuba (D & S, 1775)	2013*
Mesoligia furuncula (D & S, 1775)	1899-1960
Oligia fasciuncula (Haworth, 1809)	1899-1960
Phlogophora meticulosa (Linnaeus, 1758)	2013*
Rivula sericealis (Scopoli, 1763)	2013*
Standfussiana lucernea (Linnaeus, 1758)	2013
Xestia sexstrigata (Haworth, 1809)	2013*

Nymphalidae

Argynnis aglaja (Linnaeus, 1758)	2013
Coenonympha pamphilus (Linnaeus, 1758)	1938
Coenonympha tullia (Müller, 1764)	1938
Hipparchia semele (Linnaeus, 1758)	2013
Maniola jurtina (Linnaeus, 1758)	2013
Vanessa atalanta (Linnaeus, 1758)	2013
Vanessa cardui (Linnaeus, 1758)	2013

Oecophoridae

Agonopterix ciliella (Stainton, 1849)	2013*[i]
Agonopterix subpropinqinella f. Rhodocrella (Stainton, 1849)	2013*[i]

Pieridae

Diachrysia chrysitis (Linnaeus, 1758)	2013*
Diarsia rubi (Vieweg, 1790)	2013*
Euxoa tritici (Linnaeus, 1761)	2013
Hadena rivularis (Fabricius, 1775)	1899-1960
Hydraecia micacea(Esper, 1789)	1899-1960
Odonata	
Coenagriidae	
Ischnura elegans (Vander Linden, 1820)	1940
Orthoptera	
Acrididae	
Myrmeleotettix maculatus (Thunberg, 1815)	2013*
Omocestus viridulus	1959-1981
Plecoptera	
The one that got away!	2013*[i]
Trichoptera	
Beraeidae	
Beraea maurus (Curtis, 1834)	2013*
Limnephilidae	
Halesus radiatus (Curtis, 1834)	2013*[i]
Limnephilus hirsutus (Pictet, 1834)	1937
Limnephilus sparsus Curtis, 1934	2013[i]
Stenophylax permistus McLachlan, 1895	2013*
Other terrestrial/fresh water invertebrates	
Isopoda	
Ligiidae	
Ligia oceanica (Linnaeus, 1767)	2013
Oniscidae	
Oniscus asellus Linnaeus, 1758	2013
Philosciidae	
Philoscia muscorum (Scopoli, 1763)	1983
Araneae	
Araneidae	
Araneus diadematus Clerck, 1757	2013*
Gnaphosidae	
Drassyllus pusillus (C.L.Koch, 1833)	2013*[i]
Lycosidae	
Arctosa perita (Latreille, 1799)	2013*
Pardosa pullata (Clerck, 1757)	2013[i]
Pirata sp.	2013*[i]
Metostigmata	
Parasitidae	
Poecilochirus carabi Canestrini, 1882	2013*
Trombidiformes	
Trombidiidae	
Trombidium sp.	2013*
Opiliones	
Phalangiidae	
Mitopus morio(Fabricius, 1779)	2013*
Phalangium opilio Linnaeus, 1758	2013*
Gastropoda	
Agriolimacidae	
Deroceras reticulatum (O. F. Müller 1774)	1965-1998 (?2013)
Arionidae	
Arion ater(Linnaeus, 1758)	1965-1998
Pieris rapae (Linnaeus, 1758)	2013*
Tortricidae	
Epinotia cruciana(Linnaeus, 1761)	2013*
Syndemis musculana (Hübner, 1799)	1959-1981
Cordulegasteridae	
Cordulegaster boltonii (Donovan, 1807)	1940
Forficulidae	
Forficula auricularia Linnaeus, 1758	2013
Psocoptera	
Too mangled to do anything with.	2013*
Philopotamidae	
Philopotamus montanus (Donovan, 1813)	2013[i]
Polycentropidae	
Plectrocnemia conspersa (Curtis, 1834)	2013[i]
Psychomyiidae	
Tinodes machlachlani Kimmins, 1966	2013*
Tinodes waeneri (Linnaeus, 1758)	2013*
Porcellionidae	
Porcellio scaber Latreille, 1804	2013
Trichoniscidae	
Trichoniscus pusillus Brandt, 1833	1983
Philodromidae	
Tibellus sp.	2013*[i]
Tetragnathidae	
Tetragnatha extensa (Linnaeus, 1785)	2013*[i]
Thomisidae	
Xysticus cristatus (Clerck, 1757)	2013*[i]
Chilopoda	
Lithobiidae	
Lithobius forficatus (Linnaeus, 1758)	2013*
Lithobius melanops Newport, 1845	2013*
Diplopoda	
Julidae	
Cylindroiulus latestriatus(Curtis, 1845)	2013*
Archeognatha	
Machilidae	
Petrobius maritimus(Leach, 1909)	2013*
Lauriidae	
Lauria cylindracea(Da Costa, 1778)	2013
Lymnaeidae	
Galba truncatula(O. F. Müller, 1774)	2013*
Milacidae	

Cochicellidae	
Cochlicella acuta(Müller 1774)	2013
Cochlicopidae	
Cochlicopa lubrica(Müller, 1774)	2013
Cochlicopa lubricella(Rossmässler, 1834)	2013
Discidae	
Discus rotundatus(Müller, 1774)	1965-1998
Helicidae	
Cepaea hortensis(Müller, 1774)	2013
Cornu aspersum(Müller, 1774)	2013
Hydrobiidae	
Potamopyrgus antipodarum (Gray 1843)	2013*
Hygromiidae	
Candidula intersecta(Poiret 1801)	2013
Helicella itala (Linnaeus, 1758)	2013
Milax gagates(Draparnaud, 1801)	2013*
Oxychilidae	
Aegopinella nitidula (Draparnaud, 1805)	1965-1998
Aegopinella pura (Alder 1830)	1965-1998
Oxychilus alliarius (Miller 1822)	2013
Oxychilus cellarius (Müller 1774)	2013
Pristilomatidae	
Vitraea contracta (Westerlund, 1871)	1965-1998
Vitraea crystallina (Müller, 1774)	1959-1981
Valloniidae	
Vallonia costata (Müller, 1774)	1965-1998
Vitrinidae	
Vitrina pellucida (Müller, 1774)	1965-1998